EXTRACTION OF ESSENTIAL OILS FROM JASMINE FLOWER USING SOLVENT EXTRACTION METHOD: A STUDY OF FEED RATIO EFFECTS

THAVASELVAN A/L SUPERAMANIAM

UNIVERSITI MALAYSIA PAHANG

"Saya akui bahawa saya telah membaca karya ini dan pada pandangan saya karya ini adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan Ijazah Sarjana Muda Kejuruteraan Kimia"

Tandatangan : .....

Nama Penyelia : En. Syaiful Nizam bin Hassan

Tarikh : 1 Mei 2008

EXTRACTION OF ESSENTIAL OILS FROM JASMINE FLOWER USING SOLVENT EXTRACTION METHOD: A STUDY OF FEED RATIO EFFECTS

THAVASELVAN A/L SUPERAMANIAM

A thesis submitted in fulfillment of the requirements for the award of the degree of Bachelor of Chemical Engineering

Faculty of Chemical & Natural Resources Engineering

University Malaysia Pahang

MAY 2008

I declare that this thesis entitled "*Extraction of Essential Oils from Jasmine Flower Using Solvent Extraction Method: A Study of Feed Ratio Effects*" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name of Candidate : Thavaselvan A/L Superamaniam

Date : 1 MAY 2008

Special dedication to my beloved father and mother, K.Superamaniam and K.Saroja, all my family members that always inspire, love and stand besides me, my supervisors, my beloved friends, my fellow colleagues, and all faculty members.

For all your love, care, support, and believe in me. Thank you so much.

ACKNOWLEDGEMENT

Praise be to God for His help and guidance that finally I am able to complete this final year project as one of my requirement to complete my study.

First and foremost I would like to extend my deepest gratitude to all the parties involved in this research. First of all, a special thank to my supervisor Mr. Syaiful Nizam bin Hassan and Mr. Cheng Chin Kui for their willingness in overseeing the progress of my research work from its initial phases till the completion of it. I do believe that all their advice and comments are for the benefit of producing the best research work.

I am grateful to the staff of Faculty of Chemical and Natural Resources Engineering of University Malaysia Pahang for their cheerfulness and professionalism in handling their work. In preparing this thesis, I was in contact with many people, researches, academicians and practitioners. They have contributed towards my understanding and thoughts.

In particular, my sincere thankful is also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. And last, but not least I thank my parents and other family members for their continuous support while completing this thesis.

ABSTRACT

Jasmine essential oils are primarily used in the perfumery industry and have a very high commercial value due to its therapeutic properties. As Jasmine essential oils are composed of heat-sensitive chemical compounds, the use of conventional steam distillation technique would inevitably inflict thermal degradation to the natural fragrance. In this experimental work, solvent extraction method was employed due to its mild extracting condition and lower operating cost. Ethanol was used as the solvent due to its high availability in market. The extract compositions were compared using gas chromatography analysis. Preliminary results showed that volatile oil compounds were successfully isolated from Jasmine flowers using these solvents. It was found that the main constituents of the essential oils were benzyl acetate and benzyldehyde. Further studies also revealed that the composition and yield of essential oils influenced by the ratio of ethanol solvent to the jasmine flower. The most optimum feed ratio of jasmine flower to ethanol solvent is 1: 2 (50mg: 100mL) where it's yield is 14.65% and having process efficiency of 19%. Low yield of the jasmine essential oils can be improved by varying this ratio and carrying out the research in larger scale.

ABSTRAK

Pengekstrakan minyak bunga melur terutamanya digunakan dalam pembuatan minyak wangi dan mempunyai nilai komersil yang tinggi disebabkan oleh ciri-ciri terapinya. Minyak ini adalah terdiri daripada komponen yang sensitif pada haba, oleh itu penggunaan pengekstrakan stim sebagai salah satu cara untuk mengekstrakkan minyak ini secara tidak langsung membawa kepada kesan degradasi haba terhadap bau semulajadi minyak bunga melur. Di dalam kajian ini, pengekstrakan minyak ini dilakukan menggunakan kaedah ekstraksi pelarut kerana ia didapati sesuai untuk tujuan pengekstrakan minyak ini dan kos menggunakan cara ini lebih rendah. Jenis bahan pelarut yang digunakan ialah etanol. Sampel minyak yang didapati daripada kajian ini akan dibandingkan menggunakan analisis gas kromatografi. Keputusan kajian pada peringkat permulaan menunjukan beberapa komponen di dalam minyak ini dapat dikesan menggunakan pelarut-pelarut ini. Komponen utama di dalam minyak bunga melur yang telah dikenalpasti ialah benzil asetat dan benzaldehid. Kajian selanjutnya membuktikan pengesanan komponen dan kuantiti minyak ini adalah dipengaruhi oleh nisbah kuantiti bunga melur kepada pelarut etanol. Hasil paling optimum bagi minyak bunga melur ialah apabila nisbah kuantiti bunga melur kepada pelarut etanol ialah 1: 2(50mg: 100mL) di mana ianya memberikan hasil sebanyak 14.65% dan kecekapan proses sebanyak 19%. Hasil minyak bunga melur yang rendah ini dapat dipertingkatkan dengan mevariasikan nisbah tersebut dan melakukan kajian dengan menggunakan skala yang lebih besar.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CO_2	=	Carbon dioxide
FID	=	Flame Ionization Detector
GC	=	Gas Chromatography
GC-MS	=	Gas Chromatography - Mass Spectrometer
RI	=	Refrective Index
SFE	=	Supercritical Fluids Extraction

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Essential oils are the fragrant oils that are present in many plants. Hundreds of plants yield essential oils that are used as perfumes, food flavorings, medicines, and as fragrant and antiseptic additives in many common products.

Essential oils have been used for thousands of years. The ancient civilizations of Mesopotamia, more than 5,000 years ago, had machines for obtaining essential oils from plants. Essential oils were the primary source of perfumes for the ancient civilizations of Egypt, India, Greece, and Rome. Essential oils have been found in 3,000-year-old tombs in the Pyramids, and early Greek physicians, including Hippocrates, mentioned aromatic plant essences and oil massages for their healing and mood-enhancing qualities. The Romans associated essential oils and their fine aromas with wealth and success. Ayurvedic medicine, the world's oldest healing system, has long recommended essential oil massage as a health treatment for many conditions.

Essential oils are produced using several techniques. Distillation uses water and steam to remove the oils from dried or fresh plants, and the expression method uses machines to squeeze the oil out of plants. Other techniques may use alcohol or solvents to remove essential oils from plant materials.

Essential oils are extremely concentrated. It would take roughly thirty cups of herbal tea to equal the concentration of plant essence in one drop of essential oil. Some essential oils made from rose plants require 4,000 pounds of rose petals to make one pound of essential oil, and are thus very expensive. Lavender is one of the easiest essential oils to produce, because it only takes one hundred pounds of plant material to produce one pound of essential oil. Essential oils are generally very complex chemically, containing many different substances and compounds.Scientific research has isolated hundreds of chemicals in essential oils, and has shown many essential oils to have anti-bacterial, anti-fungal, and antiparasitic properties. Some essential oils contain more than 200 identified chemical substances.

Although there are hundreds of essential oils that are used regularly in healing treatments and perfumes, some of the more commonly used essential oils are lavender, chamomile, peppermint, tea tree oil, eucalyptus, geranium, jasmine, rose, lemon, orange, rosemary, frankincense, and sandalwood. Taking into consideration the small scale industries using conventional method which are involved in production of perfumeries literature survey was then taken up. It reveals that extracts of flowers, especially jasmine, rose, *Champak* and leaves of *davana,* have very good market.

Among flowers' most attractive perfume is jasmine flowers. This project was undertaken to explore the possibilities of having an absolute essential oils. The essential oil are so called because they were believed to represent the quintessence of odor and flavor from the flower kingdom – differ in composition properties from fatty or fixed oils, which consist for the most part of glycerides and from mineral or hydrocarbon oils. A scientific definition of the term essential or volatile oils are not possible, although several practical definitions exist. The most common one defines an essential oil as a more or less volatile material isolated from an odorous plant of a single botanical species by a physical process.

1.2 PROBLEM STATEMENT

In modern times, essential oils are used in the manufacture of high quality perfumes, as additives in many common products, and in the healing practice of aromatherapy. Aromatherapy was begun in the 1920s by a French chemist named Réné-Maurice Gattefosse, who became convinced of the healing powers of essential oils when he used lavender oil to effectively heal a severe burn on his body. Gattefosse also discovered that essential oils could be absorbed into the bloodstream when applied to the skin, and had medicinal effects inside the body. Another Frenchman, Dr. Jean Valnet, used essential oils during World War II to treat soldiers, and wrote a major book on the topic in 1964 called *Aromatherapie*. European biochemist, Marguerite Maury, performed thorough studies of how essential oils influence the body and emotions, and popularized essential oil massages as therapy. In the 1990s, aromatherapy was one of the fastest-growing alternative health treatments.

Essential oils are used in several healing systems, including aromatherapy, Ayurvedic medicine, and massage therapy. Essential oils are used for skin and scalp conditions including acne, athlete's foot, burns, cuts, dandruff, eczema, insect bites, parasites, sunburn, warts, and wrinkles. They are recommended for muscle, joint, and circulation problems such as arthritis, high blood pressure, cellulite, aches and pains, and varicose veins. For respiratory problems and infections, various essential oils are prescribed for allergies, asthma, earache, sinus infections, congestion, and colds and flu. Essential oils are also used to improve digestion, promote hormonal balance, and tone the nervous system in conditions including anxiety, depression, sexual dysfunction, and exhaustion.

Essential oils can be used as quick and effective mood enhancers, for increasing energy and alertness or reducing stress and promoting relaxation. Essential oils can be used as perfumes and lotions, and can be used as incense to improve the atmosphere in houses and offices.

In 2002, several reports were made on the benefits of tea tree oil in fighting infections. Although still preliminary, these reports will help pave the way to greater acceptance of essential oils in the mainstream medical community. In the case of tea tree oil, one small study showed its effectiveness in fighting orthopedic (bone, joint, and soft tissue) infections. Another recent study showed promising results for tea tree oil gel in topical treatment of recurrent herpes labialis.

In this project, the Jasmine flower is being used as the substrate. *Jasminum oficinalis,*or also known as Melur in Malay Language, is commonly extracted for it essential oils using hexane as solvent. Conventional steam distillation method is not suitable to process such material since it induces thermal degradation of many compounds contained in the flower. The constituents of the Jasmine solvent-extracted oils contain all the fragrance compounds (among others include benzyl acetate, benzyl benzoate, linalool, phytol, fatty acid methyl ester and paraffin). The latter compounds do not contribute to the scent of jasmine flowers. This extraction product undergoes further processing to separate fragrance compounds from these undesired co-extractives.

Solvent extraction uses very little heat so it is able to produce essential oils from whose fragrance would otherwise be destroyed or altered during steam distillation. Solvent extraction is used on delicate plants to produce higher amounts of essential oils at lower cost. Other than the study on this method it is important to improve the existing products of fragrance and also try to encourage the development of local technologies to take advantage of market opportunities.

Each method of extraction actually has its own advantages and disadvantages. This study is important in discovering solvent extraction method as the most optimal methods for capturing the total spectrum of volatile constituent in this jasmine plant. All in all, the study on this research is important in order to improve the effective extraction time for each solvent to

extract the oils and observing the preliminary study on these essential oils of jasmine flower.

1.3 OBJECTIVE

The main objective of this study on extraction of jasmine flowers is actually to carry out the preliminary study of this essential oils and promoting the solvent extraction as a promising method for the most quantitative and qualitative of this essential oils.

1.4 SCOPE OF RESEARCH WORK

This research is based on experimental studies of solvent extraction (using ethanol). In order to achieve the objectives mentioned above, three scopes have been identified:

I. Jasmine flowers were acquired locally to prepare the blended sample to be used in extraction process. A standard procedure would be developed from this research work.

II. To determine optimum feed ratio of jasmine flower and ethanol solvent producing highest quality and substantial yield of essential oil.

III. To analyze the product composition from the extraction process.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Essential oils are the volatile oils distilled from aromatic plant materials. The odor and flavor of the oils is usually dependent upon these oxygenated compounds. Many oils are terpenoids; fews are benzene derivatives. Table 2.1 shows the important constituents of the more common essential oils (Naik S.N., Lentz.H., 1989).

Table 2.1: Essential oils from some natural plant

Name	**Part of plant used**	**Botanical name**	**Important constituent**	**Uses**
Lemongrass and citronella	Leaf	*Cymbopogon spp*	Citral Citronella Terpenes	Perfumery Disinfectant
Eucalyptus	Leaf	*Eucalyptus globules Eucalyptus citriodora Eucalyptus dives*	Cineale Citronella Terpenes	Not mention
Cinnamon leaf	Leaf	*Cinnamomum zeylanicum*	Eugenol	Used to make artificial vanilla
Clove	Bud	*Eugenia caryophyllus*	Eugenol	Dentistry flavouring
Turpentine	Not mention	*Pinus spp*	Terpenes	Paints
Lavender	Flower	*Lavendula*	Linalol	Perfumery
Sandalwood	Wood	*Santaium*	Sanatols	Perfumery
Nutmeg	Nut	*Myristica*	Myristicin	Not mentioned
Almond	Nut	*Prunis*	Benzaldehyde	Not mentioned

Essential oils can be divided into two broad categories:

I. Large volume oils which are usually distilled from leafy material, (e.g. lemon grass, citronella and cinnamon leaves).
II. Small volume oils which are usually distilled from fruits, seed, buds and, to a lesser extent, flowers, (e.g. cloves, nutmeg and coriander).

Essential oils are the highly concentrated essences of aromatic plants. Aromatherapy is the art of using these oils to promote healing of the body and the mind. The oils are found in different parts of the plant such as the flowers, twigs, leaves and bark, or in the rind of fruit. For example, in roses it is found in the flowers, in basil it is in the leaves, in sandalwood in the wood, and so on. The methods used to extract the oil are time consuming and expensive and require a high degree of expertise. Given that it takes in excess of 220 pounds of rose petals to produce only 4 or 5 teaspoonfuls of oil, it is a process probably best left to professionals.

Due to the large quantity of plant material required, pure essential oils are expensive, but they are also highly effective which is only a few drops at a time are required to achieve the desired effect. Essential oils have an immediate impact on our sense of smell, also known as "olfaction". When essential oils are inhaled, olfactory receptor cells are stimulated and the impulse is transmitted to the emotional center of the brain, or "limbic system". The limbic system is connected to areas of the brain linked to memory, breathing, and blood circulation, as well as the endocrine glands which regulate hormone levels in the body. The properties of the oils, the fragrance and its effects, determine stimulation of these systems.

When used in massage, essential oils are not only inhaled, but absorbed through the skin as well. They penetrate the tissues and find their way into the bloodstream where they are transported to the organs and systems of the body. Essential oils work quickly on both the body and mind. Through our sense of smell to the olfactory nerves and our brain starts to react to the vapor from an essential oil in less than four seconds. The essential ingredients of oil when

applied to the body are also absorbed quickly into the skin via the hair follicles, some almost instantly, depending on the essential oil. Quality pure essential oils can be up to 70 times more concentrated than the plant source from which they derive. The advantage of the natural product over a chemically create substitute is that the essential oil is more complex and retains its additional anti-bacterial properties in a concentrated form.

Essential oils may be used singly or in combination to bring about curative and restorative processes in the mind and body, offering a gentle alternative to modern drugs. They can assist in the treatment of physical, emotional and mental changes, skin care and therapeutic massage. Even when used solely for sensual pleasure, they can positively enhance and enrich our daily life.

2.1.1 Harvesting

Correct harvesting is very important. The essential oil content varies considerably during the development of the plant. If the plant is harvested at the wrong time, the oil yield can be severely reduced. The oil is usually contained in oil glands, veins or hairs which are often very fragile. Handling will break these structures and release the oils. This is the reason a strong smell is given off when these plants are handled, so these plants have to be handled very carefully to prevent valuable oils being lost.

2.1.2 Examples of Essential Oils Material

2.1.2.1 Citronella and Lemongrass

The first harvest can take place 6 - 9 months after planting. Then the grass can then be harvested up to four times a year. If harvested too often, the productivity of the plant will be reduced and the plant may even die. If the plant is allowed to grow too large, the oil yield is reduced. For lemongrass it should be 1.2m high with 4 - 5 leaves. The grass should be harvested early in the morning as long as it is not raining. Harvesting can be done with machetes or simple knives.

2.1.2.2 Cinnamon Leaves

Cinnamon leaves are harvested during the wet season since the rains facilitate the peeling of the bark. Harvesting involves the removal of the stems measuring 1.2 - 5 cm in diameter. This takes place early in the morning.

2.1.2.3 Spices

It is essential that the spice is harvested correctly. The main obstacle to correct harvesting is the crop being picked immature. This is usually due to fear of theft or the farmer requiring money urgently. However, every effort should be made to wait until the spice is fully mature.

2.1.3 Grading/Quality

The criteria for essential oil quality are based on its color which is most oils should be clear, colorless and clean. Murky oil is a sign of water being present. Besides that the odor of the essential oils is also one of the criteria for essential oil quality because the odors are specific to the areas in which the plant is grown. This makes it very difficult for new producers to enter the market. Relative density, refractive density, optical rotation, solubility in ethanol and content of specific chemicals are also the other criteria for essential oil quality.

It is important to acquire only the purest essential oils, oils which have not been diluted or adulterated with any other oil or substance. As with most crops, oil quality varies from season to season and from supplier to supplier. Only the top quality first distillation oils should be used to maintain the highest possible standard. Essential oils need never be tested on animals. One of the most accurate methods of testing is liquid gas chromatograph, a proven scientific technique which identifies the active ingredients of each extract. The yield of oil is individual to each plant.

2.2 PROPERTIES AND USES OF THE ESSENTIAL OILS

Each essential oil has its own properties and uses which can classified and identified accordingly to the type of plant it was derived. Table 2.2 shows the properties and uses of the top essential oil. (Lawless, Julia., 1995).

Table 2.2: Properties and Uses of the Top Essential Oils.

Essential oil	**Biological Name**	**Properties**	**Uses**
Clory Sage	*Salvia Sclarea*	Warming, soothing, antiseptic, anticonvulsive, astringent, antiphlogistic, digestive, deodorant, tonic, uterine, bactericidal, antidepressant.	Menstrual problems, anxiety, depression, high blood pressure, acne boils, oily skin and hair, cramp, migraine, the genitor-urinary system disorders such as amenorrhoea, wrinkles, ulcers.
Eucalyptus	*Eucalyptus Globulus*	Antiseptic, analgesic, antineuralgic, antirheumatic, antispasmodic, diuretic, expectorant, antiviral, hypoglycaemic, febrifuge, vulnerary, depurative, stimulant.	Muscular aches and pains, poor circulation, rheumatoid arthritis, asthma, bronchitis, flu, cold, epidermics, chicken pox, headaches, neuralgia, throat infections, skin disorders such as burns, cuts, herpes, wounds, insect bites.
Geranium	*Pelargonium Graveolens*	Soothing, refreshing, relaxing, antidepressant, astringent, antiseptic, antihaemarrhagic, deodorant, diuretic, fungicidal, anti-inflammatory	Anxiety, adrenocortical glands and menopausal problems, sore throat, tonsillitis, cellulites, engorgement of breast, broken capillaries, eczema, hemorrhoids, oily complexion, mature skin, ulcers, wounds.
Jasmine	*Jasminum Officinale*	Analgesic (mild), antidepressant, anti-inflammatory, antiseptic, antispasmodic, aphrodisiac, carminative, cicatrisant, expectorant, galactagogue, sedative, tonic (uterine)	Depression, nervous exhaustion and stress related conditions, jasmine is said to produce the feeling of optimism, confidence, euphoria, and it is especially good in cases of apathy, indifference, or listlessness. Jasmine is also used for catarrh, coughs, laryngitis, dysmenorrhoea, labor pains,

			uterine disorders, skin problem such as dry, greasy, irritated, sensitive skin, and for muscular spasms and sprains.
Lavender	*Lavendula Vera Officinalis*	Analgesic, anticonclusive, antidepressant, antimicrobial, antirheumatic, antiseptic, antispasmodic, antitoxic, deodorant, sedative, diuretic, choleretic, hypotensive, stimulant, tonic, vulnery, cytophylatic, insecticide	Excellent first aid oil. It soothes cuts, bruises and insect bites. One of the most versatile therapeutic essences. For nervous system disorders such as depression, headache, hypertension, insomnia, migraine, sciatica, shock. Useful in treating skin conditions such as acne, allergies, athlete's foot, boils, dandruff, dermatitis, sunburn, eczema. Treatment of disorders such as rheumatism, throat infections, flu, bronchitis, and asthma.
Lemon	*Citrus Limonum*	Refreshing, antiseptic, stimulating, anti-anaemic, antirheumatic, antisclerotic, antitoxic, hypertensive, antiscorbutic, bactericidal, insecticidal, astringent, tonic,	Warts, depression, acne and indigestion, arthritis, cellulites, high blood pressure, nosebleeds, obesity, poor circulation, rheumatism, asthma, throat infections, bronchitis, cold, fever, flu. Treatment of anemia, brittle nails, corns, mouth ulcers, greasy skin, cuts, spots, and varicose veins.
Peppermint	*Menthe Piperita*	Digestive, cooling, refreshing, mentally stimulating, analgesic, anti-inflammatory, antimicrobial, antiseptic, antiviral, astringent, expectorant, stomachic, hepatic, cordial, antispasmodic.	Muscle fatigue, bad breath, toothache, bronchitis, indigestion, and travel sickness, neuralgia, muscular pains, asthma, sinusitis, spasmodic cough, cramp, dyspepsia, skin problem such as acne, dermatitis, ringworm, scabies, and nausea.

Ylang Ylang	*Cananga Odorata ver genuina*	Antidepressant, anti-infections, euphoric, relaxant, antiseptic, hypotensive, aphrodisiac, nervine, regulator, sedative (nervous), stimulant (circulatory), tonic	Depression, nervous tension, high blood pressure, hyperpnoea, (abnormally fast breathing), tachycardia, digestive upsets. For skin care such as hair growth, acne, hair rinse, oily skin, irritated and insect bites. For nervous system disorders such as frigidity, impotence, insomnia.

From Table 2.2, it can be concluded that the significant use of the essential oil is mainly in pharmaceuticals industry where most of it have the anti-depressant properties. There are also some other ways to enjoy the magnificent scent of these natural ingredients. A few drops of essential oil in radiator fragrance or light bulb ring will fill the room with a wonderful fragrance and ambience. You can choose the oils depending on the mood. You can also add one drop of Geranium oil or Myrrh oil into your facial moisturizer to bring out a radiant glow in your skin. One interesting use of this oil is to freshen the shoes by only dropping a few drops of Geranium oil directly into your shoes or place a cotton ball dabbed with a few drops of lemon oil and leave it in the shoes overnight. For student, they are recommended to use rosemary oil while reading, studying or during exams. This is because this oil is believed to promote alertness and stimulate memory. There are many other ways to apply these oils. But in this study, we do not focus on the use of it but we focus on the production of the oil.

2.3 HAZARDOUS ESSENTIAL OILS

One should bear in mind that not all essential oil are safe to be used in aromatherapy even with or without the express administration by a qualified aromatherapy practitioner. This is due to the high toxicity levels that the essential oils might have. Some of the oil can be hazardous as they can cause

severe dermal irritation and even damage the mucous membranes and delicate stomach lining in undiluted form. Hence dermal application should be avoided as a general practice; it is advisable to use essential oils only for external remedies. Oils that fall under this category are bitter almond, calamus, camphor (brown & yellow), cassia, cinnamon (bark), fennel (bitter), pine (dwarf), rue, sage (common), thyme (red), wintergreen, garlic, onion, mustard and wormwood.

2.3.1 Toxicity

Essential oil such as Ajowan, Basil (exotic), Camphor (white), Cassia, Cedarwood (Virginian), Cinnamon (leaf), clove (bud), coriander, Eucalyptus, fennel (sweet), hyssop, juniper, nutmeg, pepper (black), sage (Spanish), tagetes, thyme (white), turmeric, should be used only on dilution (at least 1:3) and for a maximum of two weeks due to toxicity levels.

2.3.2 Photo toxicity

Some oils can cause skin pigmentation if the applied area is exposed to direct sunlight. Essential oils such as bergamot, cumin, ginger, lemon, lime, orange; should not be used either neat or on dilution on the skin, if the area will be exposed to direct sunlight.

2.3.3 Pregnancy

Essential oils should be used in half the usual stated amount during pregnancy, because of the sensitivity of the growing child. Oils of adjoin, angelica, anise star, aniseed, basil, Cedarwood (all types), celery seed, cinnamon leaf, citronella, clary sage, clove, cumin, fennel (sweet), hyssop, juniper, nutmeg, Spanish sage, and thyme (white); should be totally avoided during pregnancy.

2.3.4 High blood pressure

Oils of hyssop, rosemary, sage (Spanish and common) and Thyme are to be avoided in case of high hypertension.

2.3.5 Dermal/skin irritation

Oils of basil (sweet), black pepper, borneol, cajeput, caraway, Cedarwood (Virginian), cinnamon (leaf), clove (bud), eucalyptus, garlic, ginger, lemon, peppermint, pine needle (scotch and longleaf), thyme (white) and turmeric; especially if used in high concentration may cause irritation to the skin.

2.4 EXAMPLES OF IMPORTANT ESSENTIAL OILS

Table 2.3 below shows few examples of an important essential oils which indicates their method of production, part of plant being used and also the chief constituents inside the essential oils of each plant (Naik S.N., Lentz.H., 1989).

Table 2.3: Examples of important essential oils

Name of oil	Method of production	Part of Plant used	Chief constituents
Almond, bitter	Steam	Kernels	Benzaldehyde 96%-98%
Bergamot	Expression	Peel	Linalyl acetate 40%, linalool 6%
Cinnamon	Steam	Bark	Cinnamic Aldehyde, eugenol
Clove	Steam	Buds	Eugenol 85%-95%